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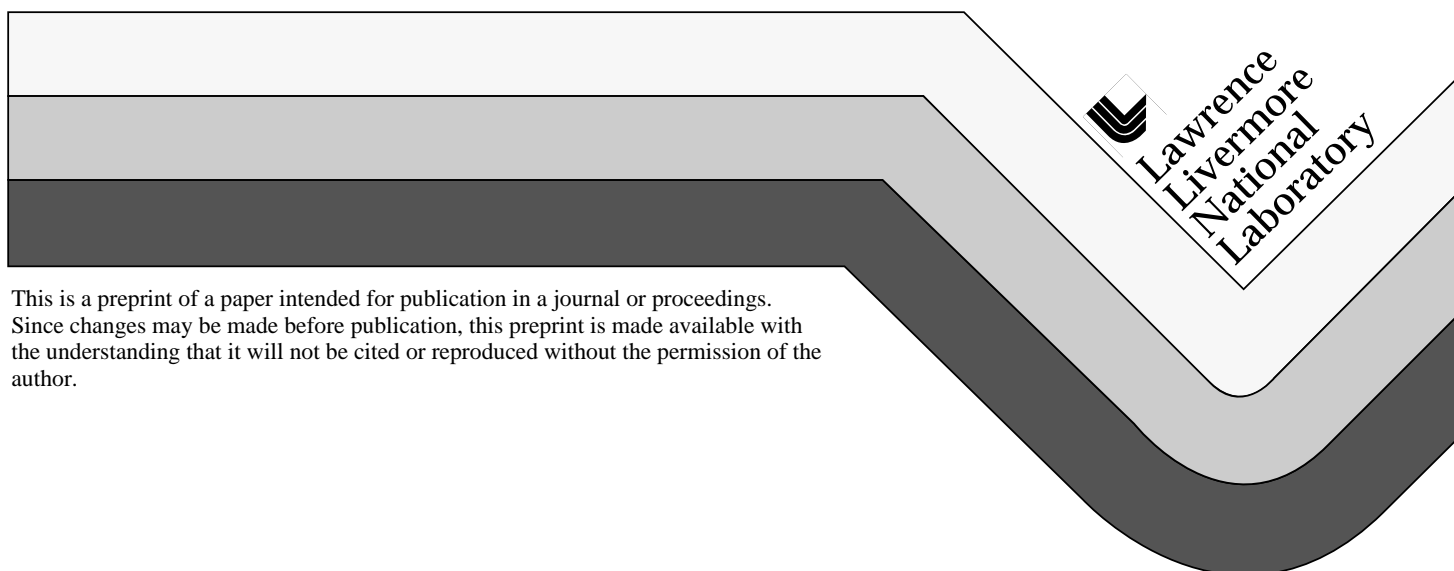
PREPRINT

A New Standard for Core Training in Radiation Safety

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A NEW STANDARD FOR CORE TRAINING IN RADIATION SAFETY

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INTRODUCTION

A new American National Standard for radiation worker training has recently been developed. The new standard is unique for such standards in that it emphasizes performance-based training and establishing a training program rather than simply prescribing objectives. The standard also addresses basic criteria, including instructor qualifications. The standard is based on input from a wide array of regulatory agencies, universities, national laboratories, and nuclear power entities. This paper presents an overview of the new standard and the philosophy behind it.

PHILOSOPHY

The purpose of the standard is to provide general recommendations regarding the development and implementation of core training for radiation safety. The standard addresses training rather than education, and focuses on establishing a performance-based training (PBT) program. The standard is intended for personnel who develop, revise, implement, or provide oversight of radiation safety training. The standard does not address training of radiation safety specialists, professionals, or technicians; nor does it address training for other non-radiological hazards.

The working group that developed the new standard was reluctant to establish a broad program of specific course objectives because of the diversity of radiation workers and because of the working group's concern that knowledge-based training might be misapplied. Also, in conformance with PBT, the group felt that the length of training should not be arbitrarily prescribed, but derived from the training system development (TSD) and process. Similarly, passing scores should not be arbitrarily established, but based on specified goals and the characteristics of test questions.

TARGET AUDIENCE

The working group generally agreed on who should receive the training covered by this standard; the difficulty was in identifying that audience — specifically. To identify the target audience as individuals who worked with radioactive material or operated radiation-generating devices would exclude a large number of individuals who might be occupationally exposed. Likewise, to base the training requirement on >100 mrem per year, would exclude the majority of individuals traditionally considered to be radiation workers. On the other hand, defining the target audience too broadly might unduly burden health and safety programs and possibly increase hazards. In the end, the working group defined the target audience in a way that does not preclude individuals simply because they are not classified as radiation workers. This audience includes: radiation workers, management and supervisory personnel, contractors, students, emergency personnel, and visitors.

The standard **shall** apply to radiation workers who are likely to receive in a year an occupational whole-body dose in excess of 100 mrem, 2% of any applicable dose limit, or whose dose could be significant if that person did not receive the training. (Note: "Likely to receive" is considered to include evaluation of normal and abnormal situations, but not accidents or emergencies.)

The standard **should** apply to radiation workers who operate radiation-generating devices or handle radioactive materials whose dose is likely to be less than 100 mrem per year or 2% of any applicable annual dose limit; however, this training program may be less formal. These workers might include individuals who do not routinely work with or in the proximity of radiation-generating devices and/or radioactive materials, but whose duties may occasionally bring them into areas where radiation exposures could occur and where it is possible that an occupational dose in excess of 100 mrem/y could be received. For example, this might include shipping clerks, secretaries, nurses, or janitors.

TOPICS

Following is a list of topics the standard recommends be included in radiation safety training. Actual topics presented and to what degree should be based on a needs evaluation, including the type and magnitude of radiological hazard that might be encountered. Topics that are not applicable should be documented as such.

Basic Radiation Theory and Fundamentals

(Information necessary to understand the training materials being presented.)

- Radiation
 - common types
 - ionizing radiation
- Units of measure
 - curie or becquerel (Ci, Bq)
 - roentgen ®
 - rad or gray (Gy)
 - rem or sievert (Sv): dose equivalent, committed dose equivalent, effective dose equivalent, total effective dose equivalent
- Types of ionizing radiation
 - type versus penetrating ability
 - internal and external hazard
- Characteristics of ionizing radiation
 - radioactivity
 - half-life: physical, biological, effective
- Fission/criticality
- Properties of specific radionuclides/radiation-generating devices
- Interaction of radiation with matter.

Sources of Ionizing Radiation

(What is it and where would the trainee expect find it?)

- Common sources of ionizing radiation
 - radiation-generating equipment
 - radioactive materials
- Sources of background radiation exposure to U.S. population
 - natural background
 - medical diagnosis and treatment
 - technologically enhanced
- Sources of occupational radiation exposure
- Radiation hazards at the facility
 - type
 - location

Biological Effects and Risk of Exposure to Ionizing Radiation

(What are the effects and relative risks?)

- Biological response to ionizing radiation
- Factors affecting biological response
 - total dose received
 - dose rate
 - type and energy of the radiation
 - area of the body irradiated
 - cell sensitivity
 - individual sensitivity
- In utero irradiation effects (teratogenic)
- Heritable effects
- Radiation risk
 - quantifying risk
 - the acceptability of risk
 - perceived versus actual risk
 - Health Physics Society Position Paper
- Hormesis

Radiation Protection Standards

- Occupational limits
- Facility control levels
- Protection of the embryo/fetus (including right of trainee to request “declared pregnant worker” status)
- General public

Minimizing Radiation Dose

(How are radiation sources controlled and how do trainees protect themselves?)

- Radiation protection policies and procedures
- Irradiation by:
 - internal sources/modes of intake
 - topical sources
 - external sources
- Radiation versus contamination
- ALARA (distinctions between the concept of ALARA and dose minimization)
- Signs, labels, posting
- Access controls
- Time, distance, and shielding
- Personal protective equipment
- Contamination control
- Waste management

Radiation/Contamination Monitoring

(How is radiation detected and measured?)

- Radiation detection, measurement and instrumentation
 - principles of detection
 - portable survey meters
 - laboratory detectors
 - personnel dosimeter
 - air samplers/monitors
- Personnel monitoring
- Area monitoring
- Environmental monitoring

Responsibilities for Radiation Protection

(What are the trainee's and what are management's responsibilities?)

- Management
- Regulators
- Radiation safety organization
- Trainee

Abnormal Conditions/Emergency Response

(How to respond to site/facility emergencies?)

Other Hazards

Because radiation workers may be exposed to hazards other than ionizing radiation, the training should include an evaluation of all hazards associated with a particular operation. For example, the risks of working at elevated temperatures for extended periods while fully suited in anti-contamination clothing and using self-contained breathing apparatus (SCBA) should be compared with the risks of working for shorter periods at more comfortable temperatures without SCBA. Training in these other hazards should be coordinated with the radiation safety training both to maximize worker safety and to enhance worker awareness of the interrelationships among the various types of hazards. Examples of other hazards are included in the standard.

DEFERMENTS/EXEMPTIONS

Deferments and exemptions are allowed in the standard. Deferments refer to training that cannot be completed before a task must be accomplished. Exemptions are releases from requirements based on previous training and/or experience. A temporary deferment from training does not imply that an exemption will be granted or that further training will not be necessary at a later date.

If a trainee has had prior training off-site, credit may be given for all or portions of that training, excluding site-specific training. Qualified personnel should be exempted from training only through methods described in a written training plan or procedure.

PERFORMANCE-BASED TRAINING

Performance-based training is designed to ensure that all of the knowledge, skills, and attitudes required to perform a particular job are identified and presented in the most effective manner. This systematic approach to training, as applied to PBT, is called Training System Development (TSD) or Instructional System Design, and consists of four phases: analysis, design, development, implement, and evaluation.

All radiation safety training should be structured using the TSD process. The training can be formal (following the guidelines of training program accreditation) or informal. But in any case, should be based on the TSD process to ensure that the training is relevant and adequate.

Analysis Phase. Here, you determine the need for training, conduct a job evaluation, and prioritize training needs. This phase normally is triggered by changes in requirements or deficiencies in performance.

Design Phase. Here, you identify the goal of the training (where you are going), the target audience (who should get there), and what the training should be (how you will get there). If any of these three elements are missing, the training may not be effective.

Development Phase. This is where you actually create the instructional methods and materials to be used in the radiation safety training program, including job performance measures, training materials and lessons plans. Training materials should be carefully critiqued and fully pilot tested before use in an actual training situation.

Implementation Phase. This is where you actually do the training, using the methods and materials that have been developed.

Evaluation Phase. All training should be evaluated to verify and improve its effectiveness. This can be done by having a senior instructor or supervisor observe the training, including practical applications and discussions of course material. Evaluation results should be documented and maintained by the organization responsible for the radiation safety training.

INSTRUCTOR QUALIFICATIONS

There are two aspects to instructor qualifications: instructional qualifications and technical qualifications. The new standard addresses technical qualifications in more detail than past standards because of the concerns of radiation and training organizations that feel they are under pressure to employ unqualified individuals.

Under the new standard, instructors must possess technical competence (theoretical and practical knowledge as well as work experience) in the subject areas they are teaching. To that end, an instructor should satisfy or exceed at least one of the following competency requirements:

- Bachelor of Science (B.S.) or equivalent degree in health physics
- B.S. or equivalent in radiological science or related field
- B.S. or equivalent in science/engineering, with documented radiation protection training
- An advanced degree in the subject area being taught
- Certification by the American Board of Health Physics
- Certification by the American Board of Medical Physicists
- Registration by the National Registry of Radiation Protection Technologists

Provisions are made for instructors who have not met degree or certification/registration requirement based on semester hour equivalencies. In addition, to maintain technical competence, an instructor must continue to perform satisfactorily on the job and should participate in continuing technical education.

For instructors who do not possess a degree, registration, or certification, the standard includes an Appendix listing acceptable equivalencies. In addition, other training programs such as those provided at shipyards, nuclear power plants, and various military, industrial, and institutional facilities may be considered in meeting the instructor qualification requirements.

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